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The End of Abundance

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GARRETT HARDIN

The Tragedy of the Commons

1968

Environmentalists of the 1960s and 1970s believed that they had lived to see Thomas Malthus's principle of population (that population outpaces food supplies) become reality. They said that the world's resources, including its fresh water, arable land, oil reserves, forests, and open spaces, groaned under the stress of unprecedented human numbers and economic growth. In the years before Garrett Hardin published "The Tragedy of the Commons," the essay from which this excerpt is taken, humans left the earth's atmosphere for the first time, and they photographed a lonely blue planet (see page 3). The photograph offered a new image of terrestrial fragility and a new metaphor: Spaceship Earth. Hardin added another element: Competition to accumulate wealth results in resource depletion, because no one has a logical motive not to consume. The essay is a statement of environmental doom, driven by the same human nature that Malthus so feared.

A finite world can support only a finite population; therefore, population growth must eventually equal zero. (The case of perpetual wide fluctuations above and below zero is a trivial variant that need not be discussed.) When this condition is met, what will be the situation of

Garrett Hardin, "The Tragedy of the Commons," *Science* 162 (December 13, 1968): 1243–48.

mankind? Specifically, can Bentham's goal of "the greatest good for the greatest number" be realized?[1]

No—for two reasons, each sufficient by itself. The first is a theoretical one. It is not mathematically possible to maximize for two (or more) variables at the same time. . . .

The second reason springs directly from biological facts. To live, any organism must have a source of energy (for example, food). This energy is utilized for two purposes: mere maintenance and work. For man, maintenance of life requires about 1600 kilo-calories a day ("maintenance calories"). Anything that he does over and above merely staying alive will be defined as work, and is supported by "work calories" which he takes in. Work calories are used not only for what we call work in common speech; they are also required for all forms of enjoyment, from swimming and automobile racing to playing music and writing poetry. If our goal is to maximize population it is obvious what we must do: We must make the work calories per person approach as close to zero as possible. No gourmet meals, no vacations, no sports, no music, no literature, no art. . . . I think that everyone will grant, without argument or proof, that maximizing population does not maximize goods. Bentham's goal is impossible. . . .

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility *to me* of adding one more animal to my herd?" This utility has one negative and one positive component.

1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.

[1]English philosopher Jeremy Bentham (1748–1832) advocated utilitarianism—the idea that the rightness of an action depends entirely on its consequences and that human actions should strive to achieve "the greatest good for the greatest number."

2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of –1.

Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another. . . . But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all. . . .

In a reverse way, the tragedy of the commons reappears in problems of pollution. Here it is not a question of taking something out of the commons, but of putting something in—sewage, or chemical, radioactive, and heat wastes into water; noxious and dangerous fumes into the air; and distracting and unpleasant advertising signs into the line of sight. The calculations of utility are much the same as before. The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. Since this is true for everyone, we are locked into a system of "fouling our own nest," so long as we behave only as independent, rational, free-enterprisers.

The tragedy of the commons as a food basket is averted by private property, or something formally like it. But the air and waters surrounding us cannot readily be fenced, and so the tragedy of the commons as a cesspool must be prevented by different means, by coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated. We have not progressed as far with the solution of this problem as we have with the first. Indeed, our particular concept of private property, which deters us from exhausting the positive resources of the earth, favors pollution. The owner of a factory on the bank of a stream—whose property extends to the middle of the stream—often has difficulty seeing why it is not his natural right to muddy the waters flowing past his door. The law, always behind the times, requires elaborate stitching and fitting to adapt it to this newly perceived aspect of the commons.

The pollution problem is a consequence of population. It did not much matter how a lonely American frontiersman disposed of his waste. "Flowing water purifies itself every 10 miles," my grandfather

used to say, and the myth was near enough to the truth when he was a boy, for there were not too many people. But as population became denser, the natural chemical and biological recycling processes became overloaded, calling for a redefinition of property rights.

Analysis of the pollution problem as a function of population density uncovers a not generally recognized principle of morality, namely: *the morality of an act is a function of the state of the system at the time it is performed.* Using the commons as a cesspool does not harm the general public under frontier conditions, because there is no public; the same behavior in a metropolis is unbearable. A hundred and fifty years ago a plainsman could kill an American bison, cut out only the tongue for his dinner, and discard the rest of the animal. He was not in any important sense being wasteful. Today, with only a few thousand bison left, we would be appalled at such behavior. . . .

Perhaps the simplest summary of this analysis of man's population problems is this: the commons, if justifiable at all, is justifiable only under conditions of low-population density. As the human population has increased, the commons has had to be abandoned in one aspect after another.

First we abandoned the commons in food gathering, enclosing farm land and restricting pastures and hunting and fishing areas. These restrictions are still not complete throughout the world.

Somewhat later we saw that the commons as a place for waste disposal would also have to be abandoned. Restrictions on the disposal of domestic sewage are widely accepted in the Western world; we are still struggling to close the commons to pollution by automobiles, factories, insecticide sprayers, fertilizing operations, and atomic energy installations.

In a still more embryonic state is our recognition of the evils of the commons in matters of pleasure. There is almost no restriction on the propagation of sound waves in the public medium. The shopping public is assaulted with mindless music, without its consent. Our government is paying out billions of dollars to create supersonic transport which will disturb 50,000 people for every one person who is whisked from coast to coast 3 hours faster. Advertisers muddy the airwaves of radio and television and pollute the view of travelers. We are a long way from outlawing the commons in matters of pleasure. Is this because our Puritan inheritance makes us view pleasure as something of a sin, and pain (that is, the pollution of advertising) as the sign of virtue?

Every new enclosure of the commons involves the infringement of somebody's personal liberty. Infringements made in the distant past are

accepted because no contemporary complains of a loss. It is the newly proposed infringements that we vigorously oppose; cries of "rights" and "freedom" fill the air. But what does "freedom" mean? When men mutually agreed to pass laws against robbing, mankind became more free, not less so. Individuals locked into the logic of the commons are free only to bring on universal ruin; once they see the necessity of mutual coercion, they become free to pursue other goals. I believe it was Hegel who said, "Freedom is the recognition of necessity."

The most important aspect of necessity that we must now recognize, is the necessity of abandoning the commons in breeding. No technical solution can rescue us from the misery of overpopulation. Freedom to breed will bring ruin to all. At the moment, to avoid hard decisions many of us are tempted to propagandize for conscience and responsible parenthood. The temptation must be resisted, because an appeal to independently acting consciences selects for the disappearance of all conscience in the long run, and an increase in anxiety in the short.

The only way we can preserve and nurture other and more precious freedoms is by relinquishing the freedom to breed, and that very soon. "Freedom is the recognition of necessity"—and it is the role of education to reveal to all the necessity of abandoning the freedom to breed. Only so, can we put an end to this aspect of the tragedy of the commons.

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RACHEL CARSON

Silent Spring

1962

Silent Spring *is the single most important book in the birth of environmentalism because of the vast popular audience it reached and because of its unprecedented message. Its publication was one of the events, along with Earth Day 1970, that first suggested that environmentalism might become a movement with a broad constituency. Carson confronted two forces considered to have delivered the triumphant victory of World War II and the rising American standard of living: science and business. She revealed that neither understood how DDT affected soils, animals, beneficial insects such as bees, or humans. In this excerpt, Carson follows the delicate and insidious path taken by chemical pesticides through the food chain and points out that they represent "a hazard we ourselves have introduced into our world as our modern way of life has evolved" (187). Carson died of cancer in 1964. Congress banned the use of DDT in 1972.*

The history of life on earth has been a history of interaction between living things and their surroundings. To a large extent, the physical form and the habits of the earth's vegetation and its animal life have been molded by the environment. Considering the whole span of earthly time, the opposite effect, in which life actually modifies its surroundings, has been relatively slight. Only within the moment of time represented by the present century has one species—man—acquired significant power to alter the nature of his world.

During the past quarter century this power has not only increased to one of disturbing magnitude but it has changed in character. The most alarming of all man's assaults upon the environment is the contamination of air, earth, rivers, and sea with dangerous and even lethal materials. This pollution is for the most part irrecoverable; the chain of evil it initiates not only in the world that must support life but in living tissues is for the most part irreversible. In this now universal contamination of the environment, chemicals are the sinister and little-recognized partners of radiation in changing the very nature of the world—the very nature of its life. Strontium 90, released through nuclear explosions into the air, comes to earth in rain or drifts down as fallout, lodges in soil, enters into the grass or corn or wheat grown there, and in time takes up its abode in the bones of a human being, there to remain until his death. Similarly, chemicals sprayed on croplands or forests or gardens lie long in soil, entering into living organisms, passing from one to another in a chain of poisoning and death. Or they pass mysteriously by underground streams until they emerge and, through the alchemy of air and sunlight, combine into new forms that kill vegetation, sicken cattle, and work unknown harm on those who drink from once pure wells. As Albert Schweitzer has said, "Man can hardly even recognize the devils of his own creation."

Rachel Carson, *Silent Spring* (New York: Houghton Mifflin, 1962), 5–13.

It took hundreds of millions of years to produce the life that now inhabits the earth—eons of time in which that developing and evolving and diversifying life reached a state of adjustment and balance with its surroundings. The environment, rigorously shaping and directing the life it supported, contained elements that were hostile as well as supporting. Certain rocks gave out dangerous radiation; even within the light of the sun, from which all life draws its energy, there were short-wave radiations with power to injure. Given time—time not in years but in millennia—life adjusts, and a balance has been reached. For time is the essential ingredient; but in the modern world there is no time.

The rapidity of change and the speed with which new situations are created follow the impetuous and heedless pace of man rather than the deliberate pace of nature. Radiation is no longer merely the background radiation of rocks, the bombardment of cosmic rays, the ultraviolet of the sun that have existed before there was any life on earth; radiation is now the unnatural creation of man's tampering with the atom. The chemicals to which life is asked to make its adjustment are no longer merely the calcium and silica and copper and all the rest of the minerals washed out of the rocks and carried in rivers to the sea; they are the synthetic creations of man's inventive mind, brewed in his laboratories, and having no counterparts in nature.

To adjust to these chemicals would require time on the scale that is nature's; it would require not merely the years of a man's life but the life of generations. And even this, were it by some miracle possible, would be futile, for the new chemicals come from our laboratories in

an endless stream; almost five hundred annually find their way into actual use in the United States alone. The figure is staggering and its implications are not easily grasped—500 new chemicals to which the bodies of men and animals are required somehow to adapt each year, chemicals totally outside the limits of biologic experience.

Among them are many that are used in man's war against nature. Since the mid-1940's over 200 basic chemicals have been created for use in killing insects, weeds, rodents, and other organisms described in the modern vernacular as "pests"; and they are sold under several thousand different brand names.

These sprays, dusts, and aerosols are now applied almost universally to farms, gardens, forests, and homes—nonselective chemicals that have the power to kill every insect, the "good" and the "bad," to still the song of birds and the leaping of fish in the streams, to coat the leaves with a deadly film, and to linger on in soil—all this though the intended target may be only a few weeds or insects. Can anyone believe it is possible to lay down such a barrage of poisons on the surface of the earth without making it unfit for all life? They should not be called "insecticides," but "biocides."

The whole process of spraying seems caught up in an endless spiral. Since DDT was released for civilian use, a process of escalation has been going on in which ever more toxic materials must be found. This has happened because insects, in a triumphant vindication of Darwin's principle of the survival of the fittest, have evolved super races immune to the particular insecticide used, hence a deadlier one has always to be developed—and then a deadlier one than that. It has happened also because . . . destructive insects often undergo a "flare-back," or resurgence, after spraying, in numbers greater than before. Thus the chemical war is never won, and all life is caught in its violent crossfire.

Along with the possibility of the extinction of mankind by nuclear war, the central problem of our age has therefore become the contamination of man's total environment with such substances of incredible potential for harm—substances that accumulate in the tissues of plants and animals and even penetrate the germ cells to shatter or alter the very material of heredity upon which the shape of the future depends.

Some would-be architects of our future look toward a time when it will be possible to alter the human germ plasm by design. But we may easily be doing so now by inadvertence, for many chemicals, like radiation, bring about gene mutations. It is ironic to think that man might

determine his own future by something so seemingly trivial as the choice of an insect spray.

All this has been risked—for what? Future historians may well be amazed by our distorted sense of proportion. How could intelligent beings seek to control a few unwanted species by a method that contaminated the entire environment and brought the threat of disease and death even to their own kind? Yet this is precisely what we have done. We have done it, moreover, for reasons that collapse the moment we examine them. We are told that the enormous and expanding use of pesticides is necessary to maintain farm production. Yet is our real problem not one of *overproduction*? Our farms, despite measures to remove acreages from production and to pay farmers *not* to produce, have yielded such a staggering excess of crops that the American taxpayer in 1962 is paying out more than one billion dollars a year as the total carrying cost of the surplus-food storage program. And is the situation helped when one branch of the Agriculture Department tries to reduce production while another states, as it did in 1958, "It is believed generally that reduction of crop acreages under provisions of the Soil Bank will stimulate interest in use of chemicals to obtain maximum production on the land retained in crops."

All this is not to say there is no insect problem and no need of control. I am saying, rather, that control must be geared to realities, not to mythical situations, and that the methods employed must be such that they do not destroy us along with the insects.

The problem whose attempted solution has brought such a train of disaster in its wake is an accompaniment of our modern way of life. Long before the age of man, insects inhabited the earth—a group of extraordinarily varied and adaptable beings. Over the course of time since man's advent, a small percentage of the more than half a million species of insects have come into conflict with human welfare in two principal ways: as competitors for the food supply and as carriers of human disease.

Disease-carrying insects become important where human beings are crowded together, especially under conditions where sanitation is poor, as in time of natural disaster or war or in situations of extreme poverty and deprivation. Then control of some sort becomes necessary. It is a sobering fact, however, as we shall presently see, that the method of massive chemical control has had only limited success, and also threatens to worsen the very conditions it is intended to curb.

Under primitive agricultural conditions the farmer had few insect

problems. These arose with the intensification of agriculture—the devotion of immense acreages to a single crop. Such a system set the stage for explosive increases in specific insect populations. Single-crop farming does not take advantage of the principles by which nature works; it is agriculture as an engineer might conceive it to be. Nature has introduced great variety into the landscape, but man has displayed a passion for simplifying it. Thus he undoes the built-in checks and balances by which nature holds the species within bounds. One important natural check is a limit on the amount of suitable habitat for each species. Obviously then, an insect that lives on wheat can build up its population to much higher levels on a farm devoted to wheat than on one in which wheat is intermingled with other crops to which the insect is not adapted.

The same thing happens in other situations. A generation or more ago, the towns of large areas of the United States lined their streets with the noble elm tree. Now the beauty they hopefully created is threatened with complete destruction as disease sweeps through the elms, carried by a beetle that would have only limited chance to build up large populations and to spread from tree to tree if the elms were only occasional trees in a richly diversified planting.

Another factor in the modern insect problem is one that must be viewed against a background of geologic and human history: the spreading of thousands of different kinds of organisms from their native homes to invade new territories. This worldwide migration has been studied and graphically described by the British ecologist Charles Elton in his recent book *The Ecology of Invasions*. During the Cretaceous Period, some hundred million years ago, flooding seas cut many land bridges between continents and living things found themselves confined in what Elton calls "colossal separate nature reserves." There, isolated from others of their kind, they developed many new species. When some of the land masses were joined again, about 15 million years ago, these species began to move out into new territories—a movement that is not only still in progress but is now receiving considerable assistance from man.

The importation of plants is the primary agent in the modern spread of species, for animals have almost invariably gone along with the plants, quarantine being a comparatively recent and not completely effective innovation. The United States Office of Plant Introduction alone has introduced almost 200,000 species and varieties of plants from all over the world. Nearly half of the 180 or so major insect

enemies of plants in the United States are accidental imports from abroad, and most of them have come as hitchhikers on plants.

In new territory, out of reach of the restraining hand of the natural enemies that kept down its numbers in its native land, an invading plant or animal is able to become enormously abundant. Thus it is no accident that our most troublesome insects are introduced species.

These invasions, both the naturally occurring and those dependent on human assistance, are likely to continue indefinitely. Quarantine and massive chemical campaigns are only extremely expensive ways of buying time. We are faced, according to Dr. Elton, "with a life-and-death need not just to find new technological means of suppressing this plant or that animal"; instead we need the basic knowledge of animal populations and their relations to their surroundings that will "promote an even balance and damp down the explosive power of outbreaks and new invasions."

Much of the necessary knowledge is now available but we do not use it. We train ecologists in our universities and even employ them in our governmental agencies but we seldom take their advice. We allow the chemical death rain to fall as though there were no alternative, whereas in fact there are many, and our ingenuity could soon discover many more if given opportunity.

Have we fallen into a mesmerized state that makes us accept as inevitable that which is inferior or detrimental, as though having lost the will or the vision to demand that which is good? Such thinking, in the words of the ecologist Paul Shepard, "idealizes life with only its head out of water, inches above the limits of toleration of the corruption of its own environment[.] . . . Why should we tolerate a diet of weak poisons, a home in insipid surroundings, a circle of acquaintances who are not quite our enemies, the noise of motors with just enough relief to prevent insanity? Who would want to live in a world which is just not quite fatal?"

Yet such a world is pressed upon us. The crusade to create a chemically sterile, insect-free world seems to have engendered a fanatic zeal on the part of many specialists and most of the so-called control agencies. On every hand there is evidence that those engaged in spraying operations exercise a ruthless power. "The regulatory entomologists . . . function as prosecutor, judge and jury, tax assessor and collector and sheriff to enforce their own orders," said Connecticut entomologist Neely Turner. The most flagrant abuses go unchecked in both state and federal agencies.

It is not my contention that chemical insecticides must never be used. I do contend that we have put poisonous and biologically potent chemicals indiscriminately into the hands of persons largely or wholly ignorant of their potentials for harm. We have subjected enormous numbers of people to contact with these poisons, without their consent and often without their knowledge. If the Bill of Rights contains no guarantee that a citizen shall be secure against lethal poisons distributed either by private individuals or by public officials, it is surely only because our forefathers, despite their considerable wisdom and foresight, could conceive of no such problem.

I contend, furthermore, that we have allowed these chemicals to be used with little or no advance investigation of their effect on soil, water, wildlife, and man himself. Future generations are unlikely to condone our lack of prudent concern for the integrity of the natural world that supports all life.

There is still very limited awareness of the nature of the threat. This is an era of specialists, each of whom sees his own problem and is unaware of or intolerant of the larger frame into which it fits. It is also an era dominated by industry, in which the right to make a dollar at whatever cost is seldom challenged. When the public protests, confronted with some obvious evidence of damaging results of pesticide applications, it is fed little tranquilizing pills of half truth. We urgently need an end to these false assurances, to the sugar coating of unpalatable facts. It is the public that is being asked to assume the risks that the insect controllers calculate. The public must decide whether it wishes to continue on the present road, and it can do so only when in full possession of the facts. In the words of Jean Rostand, "The obligation to endure gives us the right to know."

13

BARRY COMMONER

The Closing Circle

1971

Ecosystems never deplete their resources and never produce waste, and this has been their attraction for social thinkers who began to apply their principles to the ways that humans organize production and consumption. Why, they wondered, should economic activity exist outside of this model? Barry Commoner's work was among the most influential at an early stage in this debate. He is concerned with technological society and how it can be modified so as not to act as a parasite on the natural environment. In The Closing Circle, *Commoner recast the inhabited earth as the "ecosphere"—the systems and organisms that have sustained life for millions of years—and argued that toxic waste from human technology "is a threat to its finely balanced cycles." This excerpt highlights Commoner's argument that modern technology and production methods, not changing patterns of consumption, are the cause of the environmental crisis. Finding technological solutions to environmental problems remains a popular solution among environmentalists, and Commoner became one of the most distinguished advocates of this view.*

New production technologies have displaced old ones. Soap powder has been displaced by synthetic detergents; natural fibers (cotton and wool) have been displaced by synthetic ones; steel and lumber have been displaced by aluminum, plastics, and concrete; railroad freight has been displaced by truck freight; returnable bottles have been displaced by nonreturnable ones. On the road, the low-powered automobile engines of the 1920's and 1930's have been displaced by high-powered ones. On the farm, while per capita production has remained about constant, the amount of harvested acreage has decreased; in effect, fertilizer has displaced land. Older methods of insect control have been displaced by synthetic insecticides, such as DDT, and for

Barry Commoner, *The Closing Circle: Nature, Man, and Technology* (New York: Alfred A. Knopf, 1971), 144–46, 163–64, 176–77.

controlling weeds the cultivator has been displaced by the herbicide spray. Range-feeding of livestock has been displaced by feedlots.

In each of these cases, what has changed drastically is the technology of production rather than over-all output of the economic good. Of course, part of the economic growth in the United States since 1946 has been based on some newly introduced goods: air conditioners, television sets, tape recorders, and snowmobiles, all of which have increased absolutely without displacing an older product. . . . In general, the growth of the United States economy since 1946 has had a surprisingly small effect on the degree to which individual needs for basic economic goods have been met. That statistical fiction, the "average American," now consumes, each year, about as many calories, protein, and other foods (although somewhat less of vitamins); uses about the same amount of clothes and cleaners; occupies about the same amount of newly constructed housing; requires about as much freight; and drinks about the same amount of beer (twenty-six gallons per capita!) as he did in 1946. However, his food is now grown on less land with much more fertilizer and pesticides than before; his clothes are more likely to be made of synthetic fibers than of cotton or wool; he launders with synthetic detergents rather than soap; he lives and works in buildings that depend more heavily on aluminum, concrete, and plastic than on steel and lumber; the goods he uses are increasingly shipped by truck rather than rail; he drinks beer out of nonreturnable bottles or cans rather than out of returnable bottles or at the tavern bar. He is more likely to live and work in air-conditioned surroundings than before. He also drives about twice as far as he did in 1946, in a heavier car, on synthetic rather than natural rubber tires, using more gasoline per mile, containing more tetraethyl lead, fed into an engine of increased horsepower and compression ratio.

These primary changes have led to others. To provide the raw materials needed for the new synthetic fibers, pesticides, detergents, plastics, and rubber, the production of synthetic organic chemicals has also grown very rapidly. The synthesis of organic chemicals uses a good deal of chlorine. Result: chlorine production has increased sharply. To make chlorine, an electric current is passed through a salt solution by way of a mercury electrode. Consequently, mercury consumption for this purpose has increased—by 3,930 per cent in the twenty-five-year postwar period. Chemical products, along with cement for concrete and aluminum (also winners in the growth race), use rather large amounts of electric power. Not surprisingly, then, that item, too, has increased considerably since 1946.

All this reminds us of what we have already been told by advertising—which incidentally has *also* grown; for example, the use of newsprint for advertising has grown faster than its use for news—that we are blessed with an economy based on very modern technologies. What the advertisements do not tell us—as we are urged to buy synthetic shirts and detergents, aluminum furniture, beer in no-return bottles, and Detroit's latest creation—is that *all this "progress" has greatly increased the impact on the environment.*

This pattern of economic growth is the major reason for the environmental crisis. A good deal of the mystery and confusion about the sudden emergence of the environmental crisis can be removed by pinpointing, pollutant by pollutant, how the postwar technological transformation of the United States economy has produced not only the much-heralded 126 per cent rise in GNP, but also, at a rate about ten times faster than the growth of GNP, the rising levels of environmental pollution. . . .

All modern plastics, like synthetic fibers, are composed of man-made, unnatural polymers. They are, therefore, ecologically nondegradable. It is sobering to contemplate the fate of the billions of pounds of plastic already produced. Some of it has of course been burned—thereby adding to the air not only the ordinary products of combustion, but in some cases particular toxic substances such as hydrochloric acid as well. The rest remains, in some form, somewhere on the earth.

Having been designed for their plasticity, the synthetic polymers are easily formed into almost any wanted shape or configuration. Huge numbers of chaotically varied plastic objects have been produced. Apart from the aesthetic consequences, there are serious ecological ones. As the ecosphere is increasingly cluttered with plastic objects nearly infinite in their shape and size, they will—through the workings of nature and the laws of probability—find their way into increasingly narrow nooks and crannies in the natural world. This situation has been poignantly symbolized by a recent photograph of a wild duck, its neck garlanded with a plastic beer-can pack. Consider the awesome improbability of this event. A particular plastic pack is formed in a factory, shipped to a brewer, fitted around six cans of beer, further transported until it reaches human hands that separate plastic from beer can. Then, tossed aside, it nevertheless persists until it comes to float on some woodland lake where a wild duck, too trustingly innocent of modern technology, plunges its head into the plastic noose. . . .

The increase in population accounts for from 12 to 20 per cent of the various increases in total pollutant output since 1946. The affluence factor (i.e., amount of economic good per capita) accounts for from 1 to 5 per cent of the total increase in pollutant output, except in the case of passenger travel, where the contribution rises to about 40 per cent of the total. This reflects a considerable increase in vehicle miles traveled per capita. However, as already pointed out, a good deal of this increase does not reflect improved welfare, but rather the unfortunate need for increased travel incident upon the decay of the inner cities and the growth of suburbs. The technology factor—that is, the increased output of pollutants per unit production resulting from the introduction of new productive technologies since 1946—accounts for about 95 per cent of the total output of pollutants, except in the case of passenger travel, where it accounts for about 40 per cent of the total.

The foregoing conclusions are based on those instances in which quantitative data on pollution output of various productive activities are available. However, from the qualitative evidence on other pollution problems, . . . it is already apparent that they follow a similar pattern: most of the sharp increase in pollution levels is due not so much to population or affluence as to changes in productive technology.

The over-all evidence seems clear. The chief reason for the environmental crisis that has engulfed the United States in recent years is the sweeping transformation of productive technology since World War II. The economy has grown enough to give the United States population about the same amount of basic goods, per capita, as it did in 1946. However, productive technologies with intense impacts on the environment have displaced less destructive ones. The environmental crisis is the inevitable result of this counterecological pattern of growth.

Knocking on Doors at Love Canal

1983

The trauma over the toxic chemicals buried under her neighborhood of Love Canal, New York, transformed Lois Gibbs into a grassroots activist for health and safety. In 1983, she reflected on her coming of age, after having gained national attention and even having influenced the first federal law for cleaning up toxic waste (the Superfund Law) without the

Lois Gibbs, *Love Canal: My Story* (Albany: State University of New York Press, 1983), 15–16, 29–33.

aid of any of the major environmental organizations—none of which had ever pursued the problem of toxic waste before. In this excerpt from her autobiography, Gibbs and a few of her neighbors knock on doors to gain support, travel to the state capitol at Albany for a meeting with health officials, and end up at a street rally back at home, in which Gibbs is thrust before a microphone for the first time.

It was terribly warm and humid that day. The closer I got to the canal, the more I could smell it. I could *feel* it, too, it was so humid. The odor seemed to hang in the thick air. My nose began to run, and my eyes were watering. I thought it was psychosomatic. I hadn't been eating properly and I was tired. Maybe, I thought, I'm just oversensitive. But my consciousness of the danger of the chemicals was not yet roused. . . .

As I proceeded down 99th Street, I developed a set speech. I would tell people what I wanted. But the speech wasn't all that necessary. It seemed as though every home on 99th Street had someone with an illness. One family had a young daughter with arthritis. They couldn't understand why she had it at her age. Another daughter had had a miscarriage. The father, still a fairly young man, had had a heart attack. I went to the next house, and there, people would tell me *their* troubles. People were reaching out; they were telling me their troubles in hopes I would do something. But I didn't know anything to do. I was also confused. I just wanted to stop children from going to that school. Now look at all those other health problems! Maybe they were related to the canal. But even if they were, what could I do?

As I continued going door-to-door, I heard more. The more I heard, the more frightened I became. This problem involved much more than the 99th Street School. The entire community seemed to be sick! Then I remembered my own neighbors. One who lived on the left of my husband and me was suffering from severe migraines and had been hospitalized three or four times that year. Her daughter had kidney problems and bleeding. A woman on the other side of us had gastrointestinal problems. A man in the next house down was dying of lung cancer and he didn't even work in industry. The man across the street had just had lung surgery. . . . [M]aybe there *was* more to it than just the school. I didn't understand how chemicals could get all the way over to 101st Street from 99th; but the more I thought about it, the more frightened I became—for my family and for the whole neighborhood. . . .

I continued to go door-to-door. I was becoming more worried because of the many families with children who had birth defects. Then I learned something even more frightening: there had been five crib deaths within a few short blocks. . . .

We stopped at every rest stop on the way to Albany. . . . When we got to Albany, we were flabbergasted. None of us had ever been there before. We didn't know where we were. We wanted to find the South Mall Campus, where the state government buildings are concentrated. When we had located it, we would find a hotel. That way, it would be easy to get to the meeting the next morning. . . .

The following morning we drove to the mall. In the daylight, it seemed even more incredible. It's immense. Inside, it looks like a spaceship. The corridors made us feel as if we were in a huge cement-and-tile maze.

We went to Dr. David Axelrod's office, where we were told the meeting would be downstairs in a larger room because of the 161 Love Canal residents who were expected. We had brought a petition with 161 *names* on it; there was no need for the big conference room. The lady from 97th Street was already in the room. She didn't seem happy to see us though. By concidence, she and I were wearing identical shirts!

Commissioner Robert Whalen, Dr. Vianna, Dr. Axelrod (who would become the next health commissioner), Dr. Kim, and a few others were sitting on the stage. Commissioner Whalen stood up and began the meeting. He read an order stating that the residents of Love Canal were not to eat food from their gardens and that the 99th Street School would be closed during remedial construction. The bombshell came when he recommended the evacuation of pregnant women and children under the age [of] two because, he said, the state was concerned about a danger to their health. Whalen backed up this statement with data and statistics. He didn't say the state *would* move all those people, just that they *should* move. The state order stipulated only pregnant women and children under the age of two. What, I wondered, were the rest of their families supposed to do—leave them there?

With that I almost lost my cool. Then I remembered what Wayne had said about the press and the first fifteen minutes. Still, I was furious. I jumped up and said to Commissioner Whalen: "If the dump will hurt pregnant women and children under two, what for God's sake, is it going to do to the rest of us!? What do you think you're doing?" Now very emotional, I said; "You can't do that! That would be murder!"

Debbie joined in: "Wait a minute, wait a minute. My kids are *over* two. Are you trying to tell me my children are safe?" (Debbie's backyard was right on the canal. If the commissioner had made his decision two months earlier, he would have moved her, but not now.) Between the two of us, we kept the meeting in an uproar for some fifteen minutes. "We can't eat out of our garden. We can't go in our backyard. We can't have children under two. We can't be pregnant. You're telling us it's safe for the rest of us!"

Commissioner Whalen left for a ten-minute break. He said he would come back, but he didn't, and that made me angry all over again. In the meantime, I talked to Dr. Vianna. He walked up and down, up and down, insisting that he couldn't find any problem. There just wasn't that much abnormality. I told him I thought he was dead wrong. I had learned about five crib deaths myself, just by walking around, and I wasn't doing a health survey. Many women told me they had miscarried. I found sick people all around the canal. "You can't stand there and tell me there's no problem at Love Canal!" According to his survey, he didn't see any. I kept telling him the survey must not have been conducted properly. I told him about the five crib deaths, that most of those women had been breast-feeding. Dr. Vianna kept pacing. "You'll just have to get the residents to fill out health forms and sign them," he said. "You'll have to push the residents if you want to get anything done." In his own way, he was trying to be helpful; at the same time, he wasn't giving us any assurances.

When the meeting reconvened, Frank Rovers of Conestoga Rovers[1] was on the stage to explain the remedial construction plan. He was the engineer who had drawn it up. I was still boiling from my talk with Dr. Vianna, and I now attacked Rovers. "Wait a minute," I said; "What about the underground streams?" He said they would be taken care of and gave me a technical explanation I didn't understand. "Excuse me," I replied. "I'm just a dumb housewife. I'm not an expert. *You're* the expert. I'm just going to use a little common sense. You will have underground streams running through the canal beneath those pipelines. The chemicals will get out. There's no way they are going to go into your pipe. They will be *under* it. Now, how do you *take care* of that?" He answered with some more incomprehensible engineering terms. . . .

[1]Conestoga Rovers and Associates was the engineering firm hired by the State of New York to address the chemicals in Love Canal.

When we got back to Niagara Falls, we drove to my house to see the kids. My mother was standing on the sidewalk, waving both arms. "Get right over to 99th Street," she yelled. "They're having a street meeting. They've all gone crazy." I thought my *mother* had gone crazy, standing there in the middle of the street yelling at me. I was exhausted. We had had two or three hours sleep, and we had been driving much of the day. . . .

Hundreds of people were in the street, screaming, yelling, and talking—and burning papers in a bucket. I had never seen anything like it. They were like a mob, feelings were running so high. When I saw Wayne and Kathy, I got out of the car.

Tom Heisner was standing on a box, holding a microphone. "Is Lois Gibbs back from Albany yet? Is Lois Gibbs back from Albany?" I walked around hoping no one would notice me. Wayne and Kathy said they had heard about the health commissioner's statement on the radio. "It's wild. There's no one here from the health department, or any department, to explain what it means." Just then somebody in the crowd recognized me and pushed me up to the microphone.

I had never spoken to a group of people in my whole life. In high school, if I had to do a book report in front of the class, I would cut the class. It just wasn't my way. Nevertheless, I introduced myself to Tom and Lois Heisner. Tom Heisner was telling people to burn their mortgages, to tear up their tax bills. "We're not paying anything. This house is worthless, useless. It's not worth anything. It's no good. It's uninhabitable. We can't live here." And a lot of residents were doing it. They were bringing up papers and putting them in a bucket to be burned.

I was nervous. I had a habit of saying "OK" after everything I said. I would say "OK? I'd like to talk to you, OK? I'd like to talk to you about something that is going on, OK?" It was a speech habit, or maybe I had so little confidence in myself that I was asking people for permission to speak. Wayne took it upon himself to cure my habit by sticking his finger up every time I said OK—to make me conscious of what I was saying. Wayne sensed I could become a leader; in his own way, he was trying to train me.

I got up to the microphone and stood there looking out at about 400 people. Some were pregnant women, some little children, some senior citizens; there were people of all ages, colors, sexes, and sizes. Tom Heisner introduced me. All those faces were looking up, waiting for me to say something.